4.1 Early ideas of Matter

I. The Roots of Atomic Theory

A. Science has evolved over time to become what it is today (controlled experiments, technology, etc.)
   1. Modern science arose from a need to test validity

B. Greek Philosopher Democritus (460-370 B.C.) was the first person to propose that matter was not infinitely divisible
   1. Democritus proposed the idea of the atom and many kinds of atoms

C. Aristotle (384-322 B.C.) proposed that there were four major elements and no empty space could exist

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D. Dalton (1766-1844) revised Democritus theory to formulate a new atomic theory
   1. Dalton's atomic theory stated that all matter is composed of atoms and that atoms are indivisible + indestructable
   2. Dalton's Atomic Theory also stated that atoms of different elements have different properties
      a. Dalton was responsible for stating that atoms combine in <u>whole-number ratios</u>

E. Conservation of mass
   1. Dalton's atomic theory explains that the conservation of mass in chemical reactions is the result of the separation, combination, or rearrangement of atoms

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II Current Understanding of Atoms

A. Dalton was wrong about atoms not being divisible + that all atoms have the same properties of a given element

1. Atoms may be divided into subatomic particles
2. Atoms of the same element can have slightly different masses

4.2 Defining the atom

I. The atom

A. Many experiments have proven that atoms exist

1. Atom- the smallest particle of an element that retains the chemical/physical properties of that element

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B. Looking at Atoms (tunneling)

1. A scanning electron microscope (SEM) allows individuals to see atoms

II The Electron

A. Scientists wondered about the relationship between matter and electricity

B. Cathode Ray Tubes- a glass tube from which most air has been removed that passes electricity throughit

C. Sir William Crookes

1. worked with cathode ray tubes and found that radiation travels through the tube
2. cathode-ray tubes led to the invention of T.V.s

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D. By the end of the 1800s it was concluded
1. Cathode rays were a stream of charged particles
2. The particles carried a negative charge

E. Mass and the charge of the electron
1. J.J. Thompson used cathode-ray tube experiments in the late 1890s to determine charge-to-mass ratio of charged particles
a. Thompson identified the first subatomic in 1906, the electron
2. The oil-drop experiment and the charge of an electron
a. Robert Millikan determined the charge of electrons in early
→ after finding the charge of the electron, Milikan used charge-to-mass ratio to find mass of electrons
→ mass electron = 9.1×10^{-28} g

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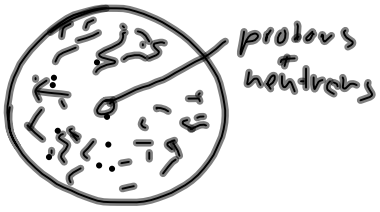
F. Plum Pudding Model
1. J.J. Thompson stated the atom is a uniform, positively charged sphere containing electrons (later discredited)



III The Nucleus
A. Earnest Rutherford showed how positively charged alpha particles interacted with solid matter

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1. He did this with the gold foil experiment which showed large positive alpha particles generally traveled through large spaces in an atom but deflected off of the positive nucleus (the center region of an atom)

B. By 1920 Rutherford refined the concept of the nucleus concluding that the nucleus contains positively charged particles

C. James Chadwick later showed that the nucleus contained a neutral particle → the neutron

IV Completing the model the atom

Figure 1C + Table 1 show properties of subatomic particles in atom

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4.3 How Atoms Differ

I. Over 110 elements, all are different

A. The number of protons identifies an atom of a particular element (atomic number)

1. Atomic number gives you number of protons and electrons

12-14 practice

II Isotopes and Mass number

A. All atoms of an element have the same amount of protons + electrons

1. Atoms may differ in their # of neutrons

a. Atoms with different # of neutrons = isotopes

b. the more neutrons, the mass increases

B. Mass number identifies the isotope of an element

1. Mass # = atomic # + # of neutrons

a. Copper-63, Copper-65

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III Mass of Atoms

A. Mass of protons + neutrons = 1.67×10^{-24} g

B. Mass of electron = 1/1840 of proton/neutron

C. Atomic Mass Unit

1. Scientists measure atomic mass in reference to carbon-12 atom

2. Carbon-12 standard = 12 atomic mass units

a. 1/12 of carbon-12 = 1 amu

b. Atomic mass = weighted average mass of isotopes of that element

1. Because isotopes have different masses, we find the atomic mass by averaging the abundances of isotopes

a. This mean average atomic mass is not always a whole number

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E. Isotope abundances

1. The abundances of an element's isotopes determines atomic mass

a. Ex: Bromine-79 (50.69%) and Br-81 (49.31%) yields an average amu of 79.904 (Br-80)

b. Bromine has an atomic mass of roughly 80 even though there is not a Br-80 isotope

→ practice problems 18-19

4.4 Unstable Nuclei and Radioactive Decay

I. Radioactivity

A. Nuclear reactions can change an element into a new element

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B. The spontaneous emission of radiation by some substances is radioactivity
1. Rays and particles of radioactive material=radiation
C. Radioactive atoms undergo changes that can alter their identities
1. Reactions that occur in the nucleus are nuclear reactions
2. Radioactive atoms emit radiation due to unstable nuclei
D. Radioactive decay
1. Unstable nuclei lose energy by emitting radiation in a process called radioactive decay
2. Unstable atoms undergo radioactive decay until they form stable atoms, often of a different element

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II Types of Radiation
A. Radiation was deflected toward a positive, negative, and neutral plate to find different types of radiation
1. Alpha radiation - radiation that deflects off of a negatively charged plate
a. Alpha particle contains 2 protons + 2 neutr
b. $^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + \alpha$ (alpha particle)
2. Beta radiation → radiation that deflects off o a positively charged plate
a. Beta (β) particle is a negative charge
b. $^{14}_{6}C \rightarrow {}^{14}_{7}$ Nitrogen $+\beta$
3. Gamma Ray (γ) - not deflected by an electri or magnetic field
a. high energy radiation
b. $^{238}_{92}U \rightarrow {}^{234}_{90}Th + \alpha + 2\gamma$
c. because gamma rays are massless their emission cannot result in a new a
→ Table 3 shows characteristics of Radi
4. Nuclear stability is determined by the amo

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